SPACE MANUFACTURING MODULE SYSTEM AND METHOD

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority from U.S. provisional application No. 60/606,410, filed Sep. 1, 2004.

TECHNICAL FIELD

[0002] The present device is related generally to manufacturing methods and systems and more specifically to manufacturing methods and systems in which the manufacturing occurs in outer space.

BACKGROUND

[0003] Outer space is an unforgiving environment. In outer space any facilities must be sufficiently self-sustaining. To achieve in greater part self sufficiency in space requires space based manufacturing capacity. This manufacturing could not only repair or replace parts of a space vehicle or space station but could also build components of larger structures needed for space exploration. To date the ability to manufacture in space is limited. This restricts space development and limits the development of habited stations beyond Earth. It is an object of the invention to provide a method and system for space manufacturing.

SUMMARY

[0004] The above objects have been achieved using a system for manufacturing in space that includes a first habitable spaced based module and a second space based manufacturing module joined to said first module. In the first module a control system allows control of manufacturing in the second module. In the second, manufacturing module a manufacturing robot and at least one manufacturing tool are controlled by the control system in the first module. A communication network allows connection of the first module to an Earth based network. An Earth based system then designs and engineers the component to be manufactured. A space based system performs safety checks prior to initiation of manufacturing operation. The manufacturing module may include a roller floor into which a panel floor having attached components is slid. The control module may have a system to monitor manufacturing, which may include windows, cameras, sensors. The modules may be joined end to end, with access doors allowing entrance. In addition, a hatch at the top of each module could allow attachment of other additional modules. These modules should be made to withstand solar radiation and may be made of strong fiber based materials (e.g., Kevlar®), titanium, and carbon-fiber. The manufacturing robot may be a track driven robot.

[0005] In an associated method, an spaced based astronaut identifies a component in need of fabrication. Specifications of this component are sent to an Earth based network. On Earth, the component is designed and engineered. The manufacturing data is then sent into space, where it is reviewed by a space based astronaut. After performing a safety review, the manufacturing instructions are transmitted to a manufacturing module, which then constructs the component. After manufacture, the component may be removed from the manufacturing module. The manufacturing step could utilize a manufacturing robot, that positions materials which are subsequently shaped, as by a laser or tapping tool. This manufacturing process may be monitored by cameras, sensors, or by observation through an observation window.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] FIG. **1** is a plan view of an interactive manufacturing module in outer space shown in network communication with Earth bound systems.

[0007] FIG. **2** is a manufacturing flow chart.

[0008] FIG. **3** is a perspective view of a manufacturing module.

[0009] FIG. **4** is a side cut-away view of the manufacturing module of FIG. **3**.

[0010] FIG. **5** is a side cut-away view of a control module.

[0011] FIG. **6** is a set of manufactured components.

DETAILED DESCRIPTION

[0012] With reference to FIG. **1**, the space manufacturing module presently described includes a astronaut module control unit (AMCU) **1** and a space manufacturing modular unit (SMMU) **2**. These may be part of a space based object **10**. The space based modules are able to communicate and share data as indicated by arrows **16**, **18**. In addition, data might be sent by both the manufacturing units and the control unit. This exchange of information with Earth bound systems is indicated by arrows **20**, **22**, **24**, **26**, **28**, and **30**. In addition the Earth based allow systems may exchange information as shown by arrows **40**, **42**.

[0013] Computer integrated manufacturing (CIM) is an operation of the total manufacturing enterprise through the use of integrated systems and data communication. This method includes the application of such technologies as computer aided design (CAD), computer aided engineering (CAE), and computed aided manufacturing (CAM). The space manufacturing is generally initiated by the space based astronaut.

[0014] "Computer Integrated Manufacturing" (CIM) may be defined as the integration of the total manufacturing enterprise through the use of integrated systems and data communication coupled with a controlling management methodology that improves organizational and personnel efficiency. In this process the functions of design and manufacturing are rationalized and coordinated using computer communication and information technology. The entire manufacturing system from product definition and material selection to the transport of the final product is analyzed such that every operation element can be designed to contribute in the most efficient and effective way to achieve enterprise goals.

[0015] The term "space manufacturing" refers to production of components in outer space. Space manufacturing may be used to produce either new structures or repair existing structures.

[0016] "Computer Aided Design" (CAD) is the application of computer software including graphic software to aid or enhance the product design from conceptualization to documentation. CAD is an essential system in engineering design. When using CAD modeling software allows for